Tipularia

The Journal of the Georgia Botanical Society Volume 19 • 2004

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Contributors

Al Good's major avocation was trees, shrubs, the natural landscape, and naturalistic landscaping while practicing a vocation as research engineer. To keep senility at bay in his declining years, he decided to learn the correct names for the plants underfoot and started hanging out with field botanists for help. When the forthcoming help was inadequate on the subject of grasses, he taught himself that one. Grasses and grassland are now the focus of his botanical and horticultural activity. He has been field trip chairman for the Tennessee Native Plant Society for the past few years.

Brad Sanders teaches graphic communications at Cedar Shoals High School in Athens, Georgia, and is the author of *Guide to William Bartram's Travels*. He received a degree in fine arts from the University of Georgia and worked in the publishing and graphic design field for twelve years before becoming a teacher. *Earth Magazine* published his article "Islands in the Land" in 1994. He has shown his photography at the State Botanical Garden of Georgia, Fernbank Museum and the Columbus Museum. His newest project is retracing and writing about Andre Michaux's travels in the Southeastern states.

Leslie Edwards, Ph.D., received her doctorate in biogeography from the University of Georgia, specializing in landscape scale vegetation-environment interactions. She has taught earth science courses at the University of Georgia and Georgia State University, and has presented papers at numerous conferences. With an undergraduate degree in English from the University of Virginia, her focus is on writing about Georgia landscapes for general audiences, to spur conservation

continued on the inside back cover

Membership

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Cover

Sabatia capitata by Richard and Teresa Ware

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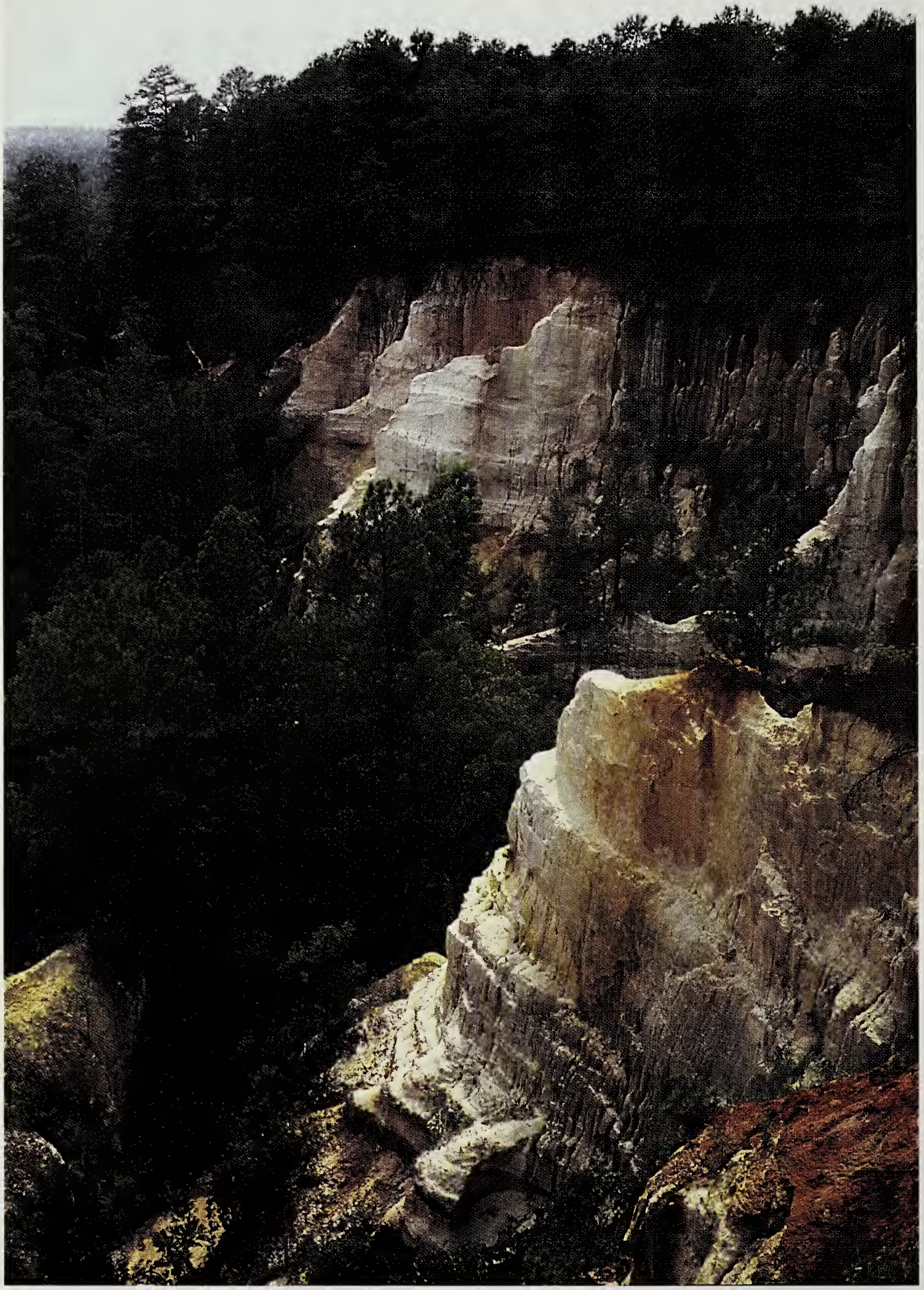

Providence Canyon State Park, view from the north rim
Brad Sanders

Downstream in Providence Canyon State Park

Leslie Edwards

Providence Canyon State Park conjures up images of spectacular landforms and colors: spires of ochre and lavender, and cliff faces limned in rust, mauve, pink and coral. The fantastical shapes are carved out of sediments that were laid down roughly 60–70 million years ago, when ancient seas lapped at what is now the Fall Line of Georgia, and the Providence Canyon area was probably a barrier island complex, like we have on our coasts today. Dinosaurs may have roamed the shores while the sea and deltas nearby were depositing the lower layers of these sediments.

These riveting thoughts occur when contemplating the now-visible sediment layers that were hidden under forests for millions of years, and that have come into our view in just the last two centuries. The catastrophic impact that revealed these sediments was not a dramatic natural event, but, simply, cotton farming. Settlers pushed west, cleared the land and started cotton farming on the Providence Canyon site in the 1830's. They did not conserve the soil, and by the 1850's gullies crisscrossed the land. By 1917, the gullies were canyons up to 150 feet deep: sediments that had been buried for millions of years were gouged away in decades. The gouged-out sediments were deposited for miles on the floor of Turner Creek, the stream that moves through Providence Canyon.

we can literally walk through time, and witness vegetation succession on the creek's floodplain, like a film on fast forward, by walking two miles down Turner Creek

This mind-boggling rearrangement of soil starts a new story on the landscape, and allows us to view a fascinating chronicle: we can literally walk through time, and witness vegetation succession on the creek's floodplain, like a film on fast forward, by walking two miles down Turner Creek. This time travel will be accompanied by a look at two unusual communities on the north-facing slopes leading up from the creek. Unlike most visitors to Providence Canyon, we will walk away from the eroded canyon lands, not around them or into them, to witness the evolution of a rich forest.

Before the settlers arrived, Turner Creek was probably a pristine stream, gurgling through a rich, narrow valley. After farming began, the eroded sediments washed from the cotton field gullies, landed in the creek and choked the stream, creating a sandy mass over fifty feet wide with small braids of water trickling through. The sands on the creek bed are fifteen feet deep in places. For a long time, nothing grew on this wide stretch of sand, because each rainstorm brought new floods of sediment from the gullies that buried or swept away all vegetation.

How does sediment that was eroded and then stored in a valley create a walk through time? Cotton farming plummeted in the early

Aesculus parviflora
(bottlebrush buckeye)
Leslie Edwards

Rhododendron prunifolium
(plumleaf azalea)
Brad Sanders

1920's and vegetation returned to hold the soils in place, so erosion greatly declined. When the erosion lessened, Turner Creek had extra energy because it no longer had to carry so much sediment. It began to cut down a new channel through the sands, becoming a true creek again. The down-cutting started about two miles downstream from the Visitor's Center and is working its way upstream. Time travel is possible because the vegetation is changing as the stream's down-cutting lowers the water table. Upstream, where the path from the Visitor's Center meets the creek, we can look at the streambed and see what the downstream area was like sixty to seventy years ago. The downstream area, meanwhile, predicts the future for upstream. The walk between takes us through the intermediate successional stages.

So, let the time travel begin. Starting at the top of Turner Creek, where the trail from the Visitor's Center meets the creek bed, floods and sediments still occasionally pour out from the canyons, so the stream is wide, sandy, and braided. Tag alder (*Alnus serrulata*) thickets have colonized the sandy, soggy soils, interspersed with black willow (*Salix nigra*), wax myrtle (*Morella cerifera*), sweetgum (*Liquidambar styraciflua*) and occasional red maple (*Acer rubrum*). Sedges (*Carex* spp.) may appear near the edges of the alder flats.

Before continuing downstream, look at the north-facing slope behind the alder. This main channel of Turner Creek is not a gully created by erosion—it has long been a creek and ravine. The north-facing aspect and steep slopes keep soils and plants protected and cool, fostering vegetation communities with northern affinities. The trees on the north slope are up to a century old all down the stream. Here, you see an unusual community of rock chestnut oak

(*Quercus montana*) and Carolina rhododendron (*Rhododendron minus*). This is perhaps the southernmost site of rock chestnut oak in the state, and seeing it preside over a Carolina rhododendron thicket is an uncanny reminder of rock chestnut oak-mountain laurel (*Kalmia latifolia*) communities in the Blue Ridge. The state-threatened plumleaf azalea (*Rhododendron prunifolium*) adds to the uniqueness of these slopes, along with large, old beech (*Fagus grandifolia*) trees, sourwoods (*Oxydendrum arboreum*), bigleaf magnolias (*Magnolia macrophylla*) and fringetrees (*Chionanthus virginicus*). This interesting environment occurs on acidic, sandy loam soils.

Croomia pauciflora (Croomia)
Steve Bowling and Leslie Edwards

Continuing the time travel back on the floodplain, the water table lowers as you proceed downstream. Note more and more saplings of sweetgum, red maple, sycamore (*Platanus occidentalis*), loblolly pine (*Pinus taeda*), river birch (*Betula nigra*), tulip poplar (*Liriodendron tulipifera*) and sourwood piercing through the alder thickets.

Less than a mile from the Visitor's Center, the suggestions of a true creek begin. The water begins to flow mostly in one channel on the far left side of the floodplain. The alder thickets are becoming a flat, dry area to the right. The alder slowly disappears and the trees become larger and denser. The sweetgum and sycamore (saplings upstream) are larger here. You are in a young floodplain forest that was alder flat roughly thirty years ago. Peeling birch bark, red maple blooms and patchy sycamore trunks are visible through tall columns of sweetgum. Blackberry (*Rubus* spp.) and broomsedge (*Andropogon virginicus*) scatter along sunny edges.

The north facing slopes change, too: they are very different communities than the upstream hillsides that host rock chestnut oak and Carolina rhododendron. Soil tests show that there are more clays, silts and nutrients in the soil here, probably because these slopes are less eroded. The vegetation reacts dramatically to the nutrients and soil moisture held by the clays and silts. Steve Bowling and I botanized a wonderful northeast-facing slope here in early March of 2004. Bloodroots (*Sanguinaria canadensis*) and rue anemones (*Thalictrum thalictroides*) gleamed like snowdrops, contrasting with the rich brown-red flowers of dwarf mimic trillium (*Trillium underwoodii*), a plant on the Georgia plant watch list. The tiny yellow blooms of leatherwood (*Dirca palustris*) cascaded down the slope amidst the emerging velvety leaves of houndstongue (*Cynoglossum virginianum*), the shiny new foliage of red buckeye (*Aesculus pavia*), the fresh greens of mountain mint (*Pycnanthemum sp.*) and raspy leaves of stiff-leaved dogwood (*Cornus asperifolia*). Steve noted the shredding bark of oakleaf hydrangea (*Hydrangea quercifolia*); the distinctive white bark of mock orange (*Philadelphus inodorus*); the striped twigs of two-winged silverbell (*Halesia diptera*) and the green stems of strawberrybush (*Euonymus americanus*). He also identified the leaves and buds of three deciduous magnolias: pyramid (*Magnolia pyramidata,* also on the Georgia plant watch list); bigleaf, and cucumber (*M. acuminata*). Southern sugar maple (*Acer barbatum*), chalk maple (*A. leucoderme*), hophornbeam (*Ostrya virginiana*), ash (probably white ash, *Fraxinus americana*), basswood (*Tilia americana*), sweetgum, water oak (*Quercus nigra*), southern shagbark hickory (*Carya carolinae-septentrionalis*), northern red oak (*Quercus rubra*), white oak (*Q. alba*) and rock chestnut oak also occur on this extraordinary, nutrient-rich site.

Streambed
Brad Sanders

Keep walking downstream and the floodplain time travel continues, demonstrating what younger upstream floodplain forests might become in forty years. Another mile or so down, Turner Creek has cut a channel fifteen feet deep. The sycamores, tulip poplars, river birch, sweetgum and red maples are over sixty years old here, much larger than they are upstream. And so, a panorama of change, from alder flat to young floodplain forest to mature floodplain forest, has unfolded in less than an hour's walk. Rarely do we find such a direct, linear procession of vegetation succession that we can hike in under an hour, especially along a stream.

More fascinating, though, is witnessing what the forest is becoming. Steve and I botanized this part of the floodplain and the adjoining north-facing slope two weeks after viewing the upstream hillside. As the water table lowers, the vegetation is changing from floodplain forest to rich bottomland. Water oak, bitternut hickory (*Carya cordiformis*), dogwood (*Cornus florida*), redbud (*Cercis canadensis*), ironwood (*Carpinus caroliniana*), beech, basswood, southern magnolia (*Magnolia grandiflora*), bigleaf magnolia, pyramid magnolia and hophornbeam now appear amidst the floodplain species. Carolina rhododendron hugs the stream bank. Leatherwood and two-wing silverbell stretch out in luxurious patches near the hillside, along with beautyberry (*Callicarpa americana*), houndstongue, yellow jessamine (*Gelsemium sempervirens*), dwarf mimic trillium, spotted wakerobin (*Trillium maculatum*), partridgeberry (*Mitchella repens*), strawberrybush, Carolina spider lilies (*Hymenocallis caroliniana*), and Virginia creeper (*Parthenocissus quinquefolia*). Abundant colonies of bottlebrush buckeye (*Aesculus parviflora*, which is rare to imperiled federally and in Georgia) tumbled down from the hillside in huge drifts many yards long and in one place, twelve feet high, set to make a stunning show in late spring.

Of course, nature is never simple. Careful observation reveals subtle patterns overlaid upon the linear walk through time. When the floods poured through a century ago, some were huge and fast, others small and slow. The floodwaters gouged out depressions and built small hummocks, creating very different growing conditions over a space of yards. Clays

and silts and sands, being different weights, were dropped by the floodwaters like a crazy quilt, so some sites are rather sterile, while others have more nutrients. Soil samples on one floodplain transect reveal that pines and sourwoods are more common in the sandy soils near the center of the floodplain (by the creek), where waters ran fastest; ashes and silverbells are concentrated in the richer sites farther from the creek, where slower waters dropped more clays and nutrients. However, many more measurements would be needed to verify this as a widespread pattern, while the presence of backwaters, topographic lows, and gullies create a complex environmental mosaic all down Turner Creek.

Turning again to the north-facing slope, soil tests again reveal high nutrient levels and loamy soils. Bitternut hickory, ironwood, hophornbeam, two-wing silverbells, bigleaf magnolia, cucumber magnolia, pyramid magnolia, southern magnolia, southern sugar maple, and basswood all grow here. During our mid-March exploration, phlox (*Phlox divaricata*) bloomed along with rue anemones, red buckeye and dwarf mimic trillium, nestled near lush drifts of Christmas ferns (*Polystichum acrostichoides*), cane (*Arundinaria gigantea*) and an unidentified sedge. The leaves of bloodroot and spiderwort (*Tradescantia* sp), bellworts (*Uvularia* sp.), widespread maidenfern (*Thelypteris kunthii*) and roundlobe hepatica (*Hepatica americana*) poked through the leaf litter. Steve noted the beautiful trunks of Shumard oaks (*Quercus shumardii*); their fine-cut leaves were scattered in the duff. Most special of all, bending to examine a phlox bloom, he found a small croomia (*Croomia pauciflora*), which is critically imperiled in Georgia, and federally rare. Returning to the site in late April, we found over seventy-five thriving plants (most of them ramets), two of which were blooming. The tiny, perfect, primitive flowers are quite stunning close up, with clustered red filaments and flat, yellow anthers.

So, when you go to the park, walk into the canyons, or survey them from the three mile trail around their rim. Revel in their color and form, and ponder the times when the sea reached the Fall Line, dinosaurs lumbered near the shores, and tropical forests covered the land. Then, venture where many visitors never go—downstream. Witness not only what erosion has carved, but also at what has been wrought by all the material that was carved away and discarded onto the creek bed. View the unusual hillsides that were spared the worst of the erosion. The fantastical thoughts of the canyons are matched by the living story of change we see walking through time down the floodplain, and the rich, protected slopes of bottlebrush buckeye, Croomia, pyramid magnolia, leatherwood and dwarf mimic trillium that border Turner Creek.

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References:

Donovan, A. D. *Stratigraphy and Sedimentology of the Upper Cretaceous Providence Formation (Western Georgia and Eastern Alabama).* Ph.D. dissertation, Colorado School of Mines, Golden, Colorado, 1985.

Edwards, L. A. *Vegetation Dynamics and Biogeomorphic Influences in a Highly Eroded Landscape.* Ph.D. dissertation, University of Georgia, Athens, Georgia, 2001.

Magilligan, F. J. and M. L. Stamp. "Historical Land-Cover Changes and Hydrogeomorphic Adjustment in a Small Georgia Watershed." *Annals of the Association of American Geographers* 87:614–635, 1997.

William Bartram's Botanical Discoveries in Georgia

Brad Sanders

In their recent book, *André Michaux in Florida*, Walter Taylor and Elaine Norman lament the fact that Michaux is not so well known or celebrated as John and William Bartram even though the Frenchman traveled farther and collected and named more plants. It is true that Michaux was a prolific collector, he was a better botanist than either of the Bartrams and he has even received credit for naming numerous plants first collected by the younger Bartram. But, it is not plant descriptions that have kept William Bartram's *Travels* in print for over two hundred years; for as anyone who has read *Travels* knows, there is more to the it than mere botany. Still, how is it that William Bartram traveled nearly 3000 miles throughout the Southern colonies, collected seeds and cuttings, made drawings of many new plants and yet his name is attached to so few species?

William Bartram was removed from the world of European academic botany where the Linnaean system was becoming widely accepted. The distance between America and Europe and slow communication prevented Bartram from becoming an expert in the new method of taxonomy. The accepted practice of the day was for American plant collectors to send their specimens to Europe where the descriptions and names would be published. John Bartram was an accomplished botanist, yet most of his plant discoveries were named by Linnaeus who published the descriptions in *Systema Naturae*. It seems that botanists and collectors viewed botanical publishing as a cooperative effort that precluded individual glory.

Whereas André Michaux and John Bartram were single-minded in their quest for new plants, William's interests were too varied to allow him to become their equal as a botanist. He drew shells, fish, fossils, birds, snakes, and other reptiles. He also wrote about the culture and myths of the Southeastern Indians. William Bartram is still known as one of the most important ethnologists of the Creek and Cherokee peoples. His list of North American birds was the longest until his protegé, Alexander Wilson, published *American Ornithology*.

William Bartram sent his specimens to his benefactor, Dr. John Fothergill, in London where they were to be cataloged according to the Linnaean system. Unfortunately Dr. Fothergill died in 1780. Fothergill's library and "cabinet" were purchased by Sir Joseph Banks who employed Dr. Daniel Solander to assist in cataloging Bank's extensive collections. Solander died in 1782 without having accomplished much with the Bartram material, perhaps because he was more intrigued by the exotic plants he and Banks collected during the Cook Expedition. Meanwhile, Bartram was working on his *Travels* which would be published in 1791. By that time several other publications had appeared and included descriptions of plants first collected by Bartram.[1] There are several explanations for the delay in publishing *Travels*; the coming of the Revolution, an injury William received from a fall while collecting seeds in a tree and not having access to his

Franklinia alatamaha (Franklin tree) Brad Sanders

specimens all handicapped him. Additionally, William Bartram was an artistic soul who did not inherit his father's methodical approach to work. I imagine William often found an excuse to leave the writing desk and head out into the garden.

When Joseph Banks died, his vast herbarium became the basis for the botanical collection of the British Museum. Most of Bartram's drawings and plant specimens are still carefully preserved in London in the Natural History Museum, but because of the delay in waiting for the descriptions, Bartram did not receive credit for many of the species that he discovered. This was one of the motivating factors in Bartram's unselfish mentorship of the young American scientists following the establishment of the new American republic. He hoped that they might not remain dependent upon the Europeans for validation, but enjoy the privilege of scientific authority.

I have gleaned from Francis Harper's *The Travels of William Bartram: Naturalist Edition* a list of plants that were first collected or mentioned by William Bartram. In some cases Bartram's description found in the *Travels* is complete enough. In other cases, it is the existence of a drawing or plant specimen in the Natural History Museum in London or the collection of the Earl of Derby that is proof of

Bartram's discovery. When Harper was working on the *Naturalist Edition* his intention was to clarify names of plants and animals found in the *Travels* and he did not address the issue of plants existing in the Bartram collections in the Natural History Museum, but not mentioned in the *Travels*. Sixty drawings and brief descriptions of 247 plants specimens that Bartram sent to England are published in *William Bartram: Botanical and Zoological Drawings, 1756–1788* by Joseph Ewan. As of yet, no botanist has taken on the exhaustive task of determining which of these plants were new to science at the time Bartram collected them.

During his travels in the southern colonies William Bartram spent a great deal of time in Georgia; April 1773 through March 1774 and January through December 1776. In June 1775 and again in January 1776 he crossed Georgia on his way to and from the Creek Nation. Most of Bartram's time in Georgia was spent on the coast where he lived with the Lachlan McIntosh family near Darien. He was, therefore, able to explore the coast and the Altamaha River extensively. What follows are some of the more important plant discoveries Bartram made in Georgia, including his description, if there is one, and place of discovery if known.

Franklinia alatamaha

Franklin tree (McIntosh County)

No other plant represents William Bartram's legacy as does *Franklinia alatamaha*. Franklinia is named for the close Bartram family friend, Benjamin Franklin, and it is the only plant that William Bartram insisted upon receiving credit for naming.

> I had the opportunity of observing the new flowering shrub, resembling the Gordonia, in perfect bloom as well as bearing ripe fruit. It is a flowering tree, of the first order for beauty and fragrance of blossoms: the tree grows fifteen or twenty feet high branching alternately; the leaves are oblong, broadest towards their extremities, and terminate with an acute point, which is generally a little reflexed; they are lightly serrated, attenuate downwards and sessile, or have very short petioles; they are placed in alternate order, and towards the extremities of the twigs are crowded together, but stand more sparsely below; the flowers are very large, expand themselves perfectly, are of a snow-white colour, and ornamented with a crown or tassel of gold coulored refulgent stamina in their centre; the inferior petal or segment of the corolla is hollow, formed like a cap or helmet, and entirely includes the other four, until the moment of expansion; its exterior surface is covered with a short silky hair; the borders of the petals are crisped or plicated: these large, white flowers stand single and sessile in the bosom of the leaves, which being near together towards the extremities of the twigs, and usually many expanded at the same time, make a gay appearance; the fruit is a large, round, dry, woody apple or pericarp, opening at each end oppositely by five alternate fissures, containing ten cells, each replete with dry woody cuniform seed. This very curious tree was first taken notice of, about ten or twelve years ago, at this place, when I attended my father (John Bartram) on a botanical excursion; but, it being then late in autumn, we could form no opinion to what class or tribe it belonged. (pages 467–468)[2]

> We never saw it grow in any other place, or have I ever since seen it growing wild, in all my travels, from Pennsylvania to Pointe Coupe, on the banks of the Mississippi, which must be allowed a very singular and unaccountable circumstance; at this place there are two or three acres of ground where it grows plentifully. (page 468)

Franklinia was last seen in the wild in 1804 and has never been found anywhere else other than at Fort Barrington on the Altamaha River. All

Hymenocallis coronaria
(shoals spider lily, Cahaba lily) Brad Sanders

known plants living today are descended from the Franklinias of the Bartram garden in Philadelphia. Franklinia is a member of the family *Theaceae*, and a relative of camellias and tea. Its growing habit suggests that it is a non-native plant and the fact that it has not been found elsewhere in the world only heightens the mystery of its origin.

Hymenocallis coronaria

Cahaba lily, rock lily, shoals spider lily (Richmond & Columbia counties)

> Upon the rich rocky hills at the cataracts of Augusta, I first observed the perfumed *Rhododendron ferruginium*, white robed *Philadelphus inodorus*, and cerulean *Malva*; but nothing in vegetable nature was more pleasing than the odoriferous *Pancratium fluitans*, which almost alone posses the little rocky islets which just appear above the water. (page 35)

This is the only reference in Bartram's *Travels* of the rare and showy plant known today as *Hymenocallis coronaria*, called Shoals Spider Lily in Georgia where Bartram discovered it. In Alabama it is called Cahaba Lily and in South Carolina it is called Rock Lily. It is often confused with the Swamp Spider Lily, *Hymenocallis crassifolia*, which grows in brackish marshes, low woods and swamp forest borders of the coastal plain as far north as the Cape Fear River in North Carolina and on the Gulf Coast as far as Texas. Whereas the Swamp Spider Lily is common and can be grown in wet areas of residential lawns the Shoals Spider Lily grows only on the rocky shoals of Piedmont rivers and only just above the fall line. Shoals Spider Lily defies domestication because of its specific habitat requirements, yet this author has seen it growing in a water fed rock garden in Plum Branch, South Carolina. Although William Bartram was the first to mention it in literature, his description was incomplete and it was left to John Eatton LeConte to describe it in 1836. It does not appear that Bartram sent a specimen of *H. coronaria* to Dr. Fothergill. It would be a difficult task to preserve a Shoals Lily flower for the webs between the straps have a brief existence and seem to melt in the hot sun as the day progresses.

Pinckneya pubens (fevertree)
Brad Sanders

Pinckneya pubens

Fevertree (McIntosh County)

Bartram found a new and singular tree growing near the site of the discovery of Franklinia. He called it *Bignonia bracteata* but it was properly described and named by André and François

Sarracenia minor (hooded pitcher-plant)
Brad Sanders

Michaux in *North American Sylva*. Fevertree is a relative of the South American Cinchona tree from which quinine is derived.

> The other new, singular and beautiful shrub, now here in full bloom I never saw grow but at two other places in all my travels, and there very sparingly, except in East Florida, in the neighbourhood of the east-coast.(page 468)
>
> The other was equally distinguished for beauty and singularity; it grows twelve or fifteen feet high, the branches ascendant and opposite, and terminate with large panicles of pale blue tubular flowers, specked on the inside with crimson; but, what is singular, these panicles are ornamented with a number of ovate large bracteae, as white, and like fine paper, their tops and verges stained with a rose red, which, at a little distance, has the appearance of clusters of roses, at the extremities of the limbs…(page 16)

Rhododendron minus (lesser rosebay)
Brad Sanders

Sarracenia minor

Hooded pitcher-plant (coastal counties)

> …and in the level wet savannas grew plentifully a new and very elegant species of Saracinia (*Saracinia lacunosa*) the leaves of the plant, which are twelve or fourteen inches in length, stand nearly erect, are round, tubular and ventricose; but not ridged with longitudinal angles or prominent nerves, as the leaves of the *Saracinia flava* are; the aperture at top may be shut up by a cap or lid, of a helmet form, which is an appendage of the leaf, turning over the orifice in that singular manner, the ventricose, or inflated part of the leaf, which is of a pale, but vivid green colour, is beautifully ornamented with rose coloured studs or blisters, and the inner surface curiously inscribed, or variegated with crimson veins or fibres. (page 417)

Bartram must have gotten *Sarracenia minor* confused with *Sarracenia leucophylla* in the *Travels* for he said that he saw it at Pensacola, but *S. minor* grows naturally only on the Atlantic coast of Georgia and north Florida.

Rhododendron minus

Piedmont rhododendron, Carolina rhododendron, lesser rosebay (Savannah and Broad rivers)

Bartram mentioned *Rhododendron ferruginium* a half dozens times in the *Travels*, but does not

Elliottia racemosa (Georgia plume)
Hugh and Carol Nourse

give a description; as though the name was self explanatory. Francis Harper identified the plant as *Rhododendron minus*. Bartram's specimen is at the Natural History Museum London. His description that accompanied the shipment to Dr. Fothergill called it "Kalmea having large clusters of rose col'd flowers." It was named by André Michaux.

Elliottia racemosa
Georgia plume

Bartram does not have an identifiable description of *Elliottia racemosa* in the *Travels*, but there is an excellent drawing of one done by Bartram that resides in the archives of the Museum of Natural History in London.

Ilex vomitoria (see back cover)
Yaupon (Liberty County)

Bartram mentioned Cassine a half dozen times in the *Travels*. He later told Benjamin Smith Barton that his *Cassine yaupon* was the *Ilex Vomitoria* of Aiton.

Befaria racemosa
Tarflower

Bartram's name for Tarflower was *Rhododendron spurium*. His description in his manuscript and a drawing in the archives of the Natural History Museum in London predate the naming of the plant by Ventenat.

Befaria racemosa (tarflower)
Brad Sanders

Lupinus villosus and *Lupinus diffusus*
Lady lupine and sandhill lupine

> I also saw a beautiful species of lupin , having pale green villous lingulate leaves; the flowers are disposed in long erect spikes; some plants produce flowers of the finest celestial blue, others incarnate, and some milk white, and though they all three seem

Lupinus diffusus (sandhill lupine)
Brad Sanders

Rhododendron calendulaceum (flame azalea)
Brad Sanders

Magnolia fraseri (Fraser magnolia)
Brad Sanders

> to be varieties of one species, yet they associate in separate communities, sometimes approaching near each other's border, or in sight at a distance. Their districts are situated on dry sandy heights, in open pine forests, which are naturally thin of undergrowth, and appear to great advantage; generally, where they are found, they occupy many acres of surface. (page 19)

Francis Harper identified Lady Lupine as a Bartram discovery, however it seems that Bartram is describing both Lady Lupine and Sandhill Lupine. Lady Lupine, *Lupinus villosus*, has pinkish flowers with a deep red spot and Sandhill Lupine, *Lupinus diffusus*, has blue flowers with a white spot.

Rhododendron calendulaceum
Flame azalea (Upper Savannah River)

Along the upper Savannah River and into the piedmont of South Carolina William Bartram was stunned by the profusion of Flame Azalea in bloom.

> ...and fiery azalea, flaming on the ascending hills or wavy surface of the gliding brooks. The epithet fiery, I annex to this most celebrated species of azalea, as being expressive of the appearance of it in flower, which are in general of the colour of the finest red lead, orange and bright gold, as well as yellow and cream colour; these various splendid colours are not only in separate plants, but frequently all the varieties and shades are seen in separate branches on the same plant, and the clusters of the blossoms cover the shrubs in such incredible profusion on the hill sides, that suddenly opening to view from dark shades, we are alarmed with the apprehension of the hills being set on fire. (pages 322–323)

Magnolia fraseri
Fraser magnolia (Rabun County)

As he traveled through present-day Rabun County, William Bartram discovered a new magnolia growing on the slopes of Rabun Bald.

> This exalted peak I named Mount Magnolia (*Magnolia auriculato*) from a new and beautiful species of that celebrated family of flowering trees, which here, at the cascades of Falling Creek, grows in a high degree of perfection, for although I had noticed this curious tree several times before, particularly on the high ridges betwixt Sinica and Keowe, and on ascending the first mountain after leaving Keowe, when I observed it in flower, but here it flourishes and commands our attention. (page 339)

Bartram then gives a complete description of Fraser Magnolia, but his *Magnolia auriculato* is *nomen nudem*.

Hydrangea quercifolia (oakleaf hydrangea)
Brad Sanders

Hydrangea quercifolia
Oakleaf hydrangea (Crawford County)

> I observed here a very singular and beautiful shrub, which I suppose is a species of Hydrangea (*Hydrangea Quercifolia*). It grows in coppices or clumps near or on the banks of rivers and creeks; many stems usually arise from a root, spreading itself greatly on all sides by suckers or offsets; the stems grow five or six feet high, declining or diverging from each other, and are covered with several barks or rinds, the last of which being of a cinerous dirt colour and very thin, at a certain age of the stems or shoots, cracks through to the next bark, and is peeled off by the winds, discovering the under, smooth, dark reddish brown bark, which also cracks and peels off the next year, in like manner as the former; thus every year forming a new bark; the stems divide regularly or oppositely, though the branches are crooked or wreathe about horizontally, and these again divide, forming others which terminate with large heavy pannicles or thyrsi of flowers, but these flowers are of two kinds; the numerous partial spikes which compose the pannicles and consist of a multitude of very small fruitful flowers, terminate with one or more very large expansive neutral or mock flowers, standing on a long, slender, stiff peduncle; these flowers are composed of four broad oval petals or segments, of a dark rose or crimson colour at first, but as they become older acquire a deeper red or purplish hue, and lastly are of a brown or ferruginous colour… (pages 382–383)

Aesculus parviflora (bottlebrush buckeye)
Brad Sanders

Aesculus parviflora
Bottlebrush buckeye (Chattahoochee River)

> I shall just mention a very curious nondescript shrub, which I observed growing in the shady forests, beneath the ascents, yet bordering on the right low lands of the river (Chattahoochee). This stoloniferous shrub grows five or six feet in height; many stems usually ascend from a root or the same source; these several stems diverge from each other, or incline a little towards the earth covered with a smooth whitish bark, divided oppositely, and the branches wreath and twist about, being ornamented with compound leaves; there being five lanceolate serrated leaves, associated upon one general long slender petiole, which stand oppositely, on the branches, which terminate with a spike, or pannicle of white flowers, which have an agreeable scent; from the characters of the flowers, this scrub appears to be a species of *Aesculus* or *Pavia*, but as I could find none of the fruit and but a few flowers, quite out of season and imperfect, I am not certain. (page 395)

Aesculus sylvatica (painted buckeye)
Hugh and Carol Nourse

Nyssa ogeche (Ogeechee lime)
Brad Sanders

Aesculus sylvatica
Painted buckeye

Bartram mentions seeing *Aesculus sylvatica* several times while exploring the Georgia Piedmont but he described it in the *Travels* from specimens found on the Cape Fear River of North Carolina.

Prunus angustifolia
Chickasaw plum (Taliaferro County)

Bartram found Chickasaw Plum throughout the Piedmont and named it *Prunus Chicasaw*.

> The Chicasaw plumb I think must be excepted, for though certainly a native of America, yet I never saw it wild in the forests, but always in old deserted Indian plantations: I suppose it to have been brought from the S. W. beyond the Mississippi, by the Chicasaws.(page 38)

Prunus angustifolia (Chickasaw plum)
Hugh and Carol Nourse

Nyssa ogeche
Ogeechee lime (Glynn County)

> I saw large, tall trees of the *Nyssa coccinea*, si. *Ogeeche*, growing on the banks of the river. They grow in the water, near the shore. There is no tree that exhibits a more desirable appearance than this, in the autumn, when their fruit is ripe, and tree divested of its leaves; for then they look as red as scarlet, with their fruit, which is of that colour also. It is of the shape, but larger than the olive, containing an agreeable acid juice. The leaves are oblong lanceolate and entire, somewhat hoary underneath; their upper surface of a full green, and shining; the petioles short, pedunculis multifloris. The most northern settlement of this tree, yet known, is on Great Ogeeche, where they are called Ogeeche limes, from their acid fruit being about the size of limes, and their being sometimes used in their stead. (page 17)

Granite Outcrops

William Bartram was one of the first writers to describe plant communities living together in ecosystems and he often drew animals and plants that were associated with one another in nature. He described a granite flat rock near Rocky Comfort Creek in Warren County, Georgia. These outcrops are peculiar to the Piedmont of Alabama, Georgia and South

Heggie's Rock Preserve
Brad Sanders

Carolina and Bartram was the first to recognize their special plant communities. Heggies Rock lies near where Bartram traveled in Columbia County and is the finest example of a granite outcrop.

Notes

1. Humphrey Marshall, *Arbustum Americanum*, 1785; Thomas Walter, *Flora Caroliniana*, 1788; William Aiton, *Hortus Kewensis*, 1789.

2. All quotes are taken from *Travels Through North & South Carolina, Georgia, East & West Florida, the Cherokee Country, the Extensive Territories of the Muscogulges, or Creek Confederacy, and the Country of the Chactaws*, by William Bartram. Published in Philadelphia, 1791. Original spellings are retained.

Bibliography

Bartram, William. *Travels Through North & South Carolina, Georgia, East & West Florida, the Cherokee Country, the Extensive Territories of the Muscogulges, or Creek Confederacy, and the Country of the Chactaws*. Published in Philadelphia, 1791.

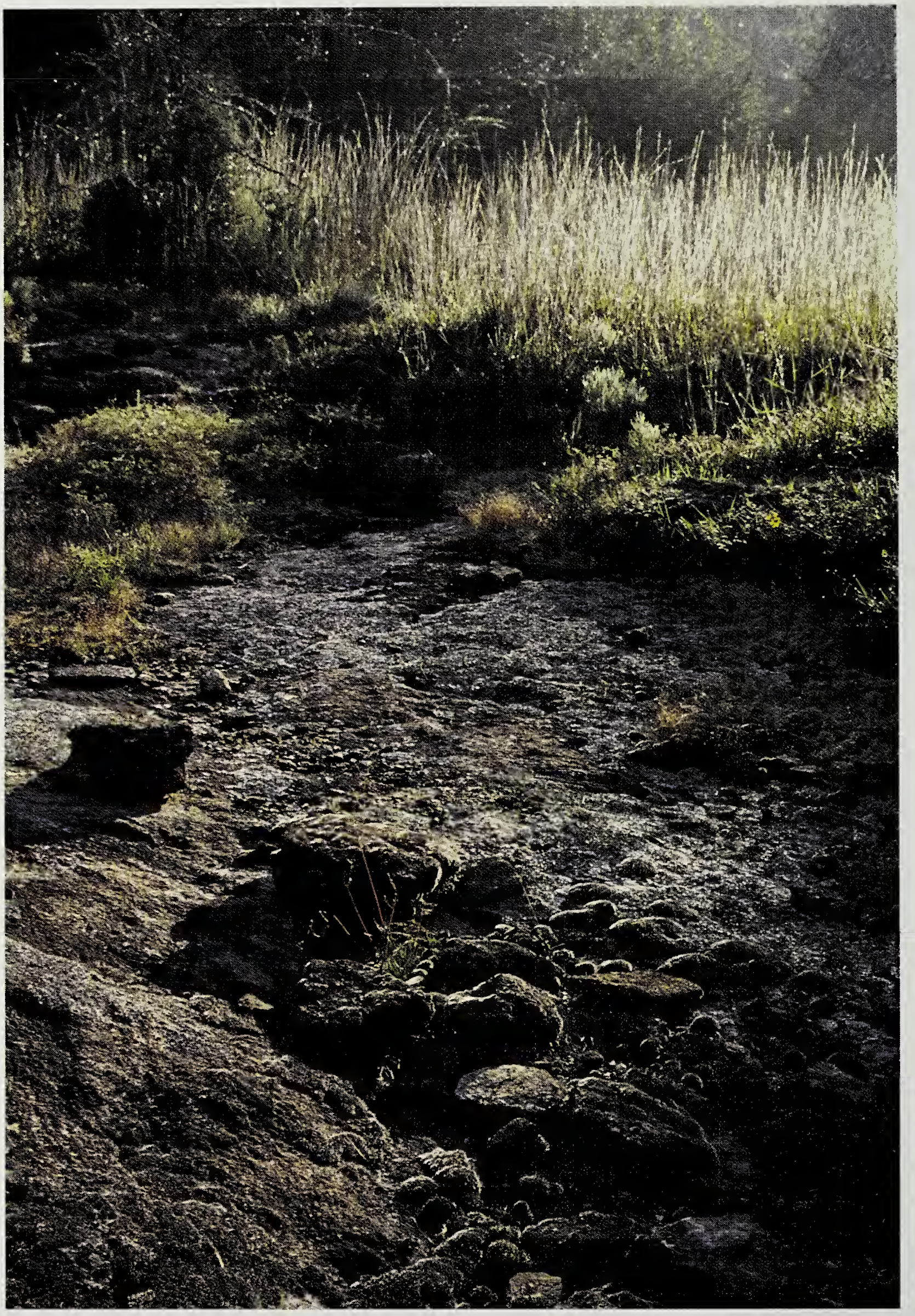
Bartram, William. *Travels and Other Writings*, edited by Thomas P. Slaughter. Library Classics of the United States, New York, 1996.

Bartram Heritage. Bartram Trail Conference, 1979.

Duncan, Wilbur and Marion Duncan. *Trees of the Southeastern United States*. University of Georgia Press, Athens, 1988.

Ewan, Joseph. *William Bartram: Botanical and Zoological Drawings, 1756–1788*. American Philosophical Society, Philadelphia, 1968.

Harper, Francis. *The Travels of William Bartram, Naturalist Edition*. University of Georgia Press, Athens, 1998.



Little People Rock and *Andropogon* (early morning)
Hugh and Carol Nourse

Flora of Rock and Shoals Outcrop Natural Area

Hugh and Carol Nourse

Introduction

Good news! Athens-Clarke County has bought "a piece of the rock." It has added over twenty acres to Rock and Shoals Outcrop Natural Area. Rock and Shoals is an area of about eighty acres containing one large granitic flatrock outcrop and many smaller outcrops. For many years the landowner had allowed plant biology students at the University of Georgia to explore the site's unique plant community, which included some rare and disjunct plants. In 1999 the Georgia Natural Heritage Program used funds from the RiverCare 2000 program to acquire 36.4 of the eighty acres containing the outcrops. It was disappointing that the boundary of the protected area enclosed only half of the largest exposed rock area. That was remedied in 2003 when the Athens-Clarke County unified government purchased an additional 22.4 acres with some of its Greenspace Program funds from the State. Today the Georgia Natural Heritage Program and the Athens-Clarke County government are drafting an intergovernmental agreement for the joint management of the 58.8 acres now protected. Public access to the site will be worked out in this agreement before the site is officially opened. Meanwhile there is a short marked trail along a creek, leading to one of the small outcrops.

Aerial photos from 1938 show the large central outcrop and several smaller peripheral outcrops. In addition the photos show that much of Rock and Shoals was terraced for cotton production. Today these terraces are still evident from ground level, although they are now overgrown with trees. Thus the land adjacent to the rock outcrop is an example of old field succession in the Piedmont, today covered by an oak-hickory-pine forest. The most abundant understory tree along the creeks and on the terraces is hop hornbeam (*Ostrya virginiana*).

Piedmont Granitic Outcrops

Piedmont granitic outcrops have been exposed for millions of years. They were formed when magma intruded into preexisting country rock about 300–350 million years ago. The magma did not reach the surface, but cooled and solidified ten miles or more beneath the surface. Over millions of years the land was uplifted and the overlying rock eroded away to expose the granite. Ninety percent of the exposed rock in the Southeastern Piedmont occurs in Georgia with the major concentration just east of Atlanta. Stone Mountain is one of the latest to be exposed, yet it has been bare rock for at least fifteen million years [Wyatt and Allison (2000)].

We refer to the outcrops as granitic even though they are not all granite, but made up of several related rock types. The small differences in composition of the rock affect the plant community only indirectly by causing differences in how the rock weathers. It is in the depressions, cracks, and fissures caused by erosion that plants gain a foothold. The rock at Rock and Shoals is mostly bedrock gneiss (Patrick 1998) of a form that does not weather into

Diamorpha smallii (elf orpine) Hugh and Carol Nourse

the round depressions that form vernal pools. Although Rock and Shoals lacks the federally threatened or endangered rare plants found in the vernal pools of some outcrops, the seeps and differing depths of soil do harbor other rare outcrop plants. Soil depth is a critical factor in understanding the distribution of the various plants.

The outcrops have areas of bare rock interspersed with areas of very thin sandy or gravelly soil. They do not hold water, losing ninety-five percent of rainfall as runoff. Temperatures in mid-summer can be extreme, registering 120 or more degrees Fahrenheit at the rock surface [Wyatt and Allison (2000)], thus, they function much as desert islands in a sea of Piedmont forest. Plants that can survive on outcrops have adapted to the desert conditions. Some are succulent, storing water in fleshy stems and leaves. Some have hairy leaves and stems that may reflect sunlight and reduce evaporation, or linear or finely dissected leaves that may reduce heat gain. Many are winter annuals, finishing their life cycles before summer's heat and drought.

The antiquity, isolation and severe conditions of these outcrop habitats have produced plant communities very different from the surrounding communities. Close relationships of some of the plants to southwestern species suggests that during a warmer and drier time millions of years ago flora from the Southwest spread to the East. This group includes confederate daisy (*Helianthus porteri*), bear-grass (*Yucca filamentosa*), prickly pear (*Opuntia humifusa*), and fameflower (*Talinum teretifolium*), which are all found at Rock and Shoals. These desert-adapted plants have survived on the outcrops, whereas in other Piedmont habitats they no longer have an advantage now that the climate is cooler and wetter [Wyatt and Allison (2000)].

Although it needs further study, Wyatt and Allison (2000) discuss studies that suggest that some weedy plants such as small bluet (*Houstonia pusilla*), dwarf dandelion (*Krigia virginica*), false-garlic (*Nothoscordum bivalve*), toadflax (*Nuttallanthus canadensis*) and Venus' looking-glass (*Triodanis perfoliata*) actually may have

originated on rock outcrops and then spread to disturbed areas in the Coastal Plain where conditions were appropriate for them. All of these plants may be found at Rock and Shoals.

Generally in the Piedmont the climax environment is an oak-hickory-pine forest. Settlers cut down the original forests for agriculture and pasture land. In the twentieth century much of it was abandoned and has returned to a secondary oak-hickory-pine forest if it has not been converted to other uses. The idea of succession is often applied to outcrops as well: lichens and mosses attach to bare rock and create soil, which then supports annuals, and with further soil accretion plants that need the deeper soils can grow. But recent studies suggest that this succession process is doubtful on the outcrops. Sometimes it happens; sometimes conditions remain static for a long time or revert to previous stages [Wyatt and Allison (2000)].

Although rock outcrops are ancient, they are threatened by exotic plants and by people. Rock and Shoals is next to pasture land, a source of waste area weeds. Chinese privet (*Ligustrum sinense*) is a major problem. Autumn olive (*Elaeagnus umbellata*) and Japanese honeysuckle (*Lonicera japonica*) are of lesser concern but still pose significant threats. Human activities also threaten the survival of the habitat. Many sites have been quarried. At Rock and Shoals quarrying was attempted many years ago, but fortunately was abandoned after a few experimental blasts. Over the years trash has been dumped at Rock and Shoals, everything from refrigerators and toilets to sofas. Some consider outcrops good for little else. Bikes, off-road vehicles, horses, and even foot traffic can destroy delicate plant communities. These inappropriate uses will be discouraged in the management of this site. If general access is permitted by the new management plan, the foot trails will have to be carefully routed to minimize damage to some of the communities.

Plant Inventory and Bloom Times

Three Bot Soc Botanical Guardians, Liese DerVartanian and the authors, visited the site nearly every week during 2001 and 2002, to identify plants and record bloom times. James Allison, Tom Patrick, and Elaine Nash also provided help in identifying some of the plants found. We used Radford, et. al. (1968) as our key, with name updates found at the USDA website for the Integrated Taxonomic Information System (2002). For lichens we used Barodo, et. al. (2001).

In this report we will concentrate on the outcrop plant communities found in the following habitats: bare rock; areas with soil too thin for grasses; areas with grasses and herbs but no woody plants; seepage areas that harbor wetland plants; and areas of thin woods on the edges of the main rock. We will not discuss plants found in soils deep enough to support typical Piedmont forest.

Bare Rock

Only two species colonize the bare rock. Peppered rock shield (*Xanthoparmelia conspersa*) is a foliose lichen which grows in circular patterns flat against the rock. Its blue-gray tones are most vivid during the cool moist winter months. Resurrection moss (*Grimmia laevigata*) is bright green touched with silver when damp, but turns silvery black in the heat and drought of summer unless it has recently rained. It is aptly named: if you pour water from a canteen onto dry black resurrection moss you can watch it green up almost instantly. These two species cover a large percentage of what might otherwise be bare rock.

Soil Too Thin for Woody Plants

In depressions in the rock or at the edges of colonies of resurrection moss or peppered rock shield, bits of sand, gravel and plant debris collect to form a thin soil. In the winter, if you get down on hands and knees, you can see the rosettes of elf orpine (*Diamorpha smallii*) and of sandwort (*Minuartia uniflora*) in these thinnest soils. From March to May this community is a carpet of red and white. Although the elf orpine flower is white, it is the color of the succulent red stems and leaves that stands out.

Sometimes elf orpine is embedded in the resurrection moss, which, when green after a rain, makes an attractive background. The sandwort forms masses of white flowers in slightly deeper soil. The two plants do not mix, but appear as bands of color. The best time to see their display on the outcrop is mid-April. In summer the dried stems of elf orpine and sandwort hold their seeds above the hot soil. Only in the fall when the rains come does the seed drop. These annuals must grow quickly from winter rosettes to flower and produce seed for the next generation before summer's heat and drought kill the parent plants.

From June to August you will also find fameflower (*Talinum teretifolium*), rushfoil (*Croton willdenowii*, syn. *Crotonopsis elliptica*) and granite sedge (*Cyperus granitophilus*) in these thin soils. Fameflower, a succulent perennial, raises its tiny flower about a foot off the hot sand. It blooms around 4 p.m., and then only if it is not too cloudy. As summer turns into fall the rushfoil leaves turn a beautiful copper color.

The spring-blooming prickly pear cactus (*Opuntia humifusa*) grows at the edges of rocks between the thin soil areas and the grassy areas that we discuss next.

Grassy Herb Communities

At Rock and Shoals the grassy herb area is extensive. Elaine Nash when visiting the site with us declared, "Why, this is a grassland!" In winter the dried stems of the dominant grasses make the area a beautiful sea of gold and tan. Various species of lichens, particularly granite thorn lichen (*Cladonia caroliniana*), gray reindeer lichen (*Cladina rangiferina*) and Dixie reindeer lichen (*Cladina subtenuis*) show between the clumps of grasses. In summer you know you are walking where you shouldn't when you hear and feel the dry lichens crunching under foot. The dominant grass is little blue stem (*Schizachyrium scoparium* var. *scoparium*), but other tall grasses include broomsedge (*Andropogon virginicus*) and split-beard (*Andropogon ternarius*).

In spring this community includes many beautiful herbs. In April come sunnybells (*Schoenolirion croceum*) and Small's ragwort (*Packera anonyma*, syn. *Senecio anonymus* or *S. smallii*) in amongst last year's dried grasses. Several weeks later the sunnybells will be gone, but Small's ragwort will still be around and will be joined by sundrops (*Oenothera fruticosa*). Still later the false dandelion (*Pyrrhopappus carolinianus*) will appear. By the end of May milkwort (*Polygala curtissii*) shows up all over the open grassy area.

In June tickseed sunflower (*Coreopsis grandiflora*) joins the sundrops, false dandelion, and milkwort. Depending on the rains these flowers may stick around while the leaves and stems of tall grasses elongate in late summer. By July pineweed (*Hypericum gentianoides*) sports tiny yellow blossoms on its many slender green branches.

In September confederate daisy puts on its display if the summer has not been too dry. At Rock and Shoals the daisies are dispersed among the grasses, with a quieter beauty than on some outcrops where they are massed by themselves with rock all around.

Seeps

Unless there is a severe drought during the middle of the summer, the seeps are wet year around. Bloom time comes a little later in seep habitats. In late April or early May the false pimpernel (*Lindernia monticola*) begins to bloom. Only a few inches high with tiny flowers of white with purple marking, it seems too delicate to remain into the summer. But as long as the seeps are wet it flowers from May 1 into September. At about the same time the horned bladderwort (*Utricularia cornuta*) can be found. Dwarf hatpin (*Eriocaulon koernickianum*) blooms in May and June, although we have found it still flowering later in the summer. It is a disjunct plant that mainly grows in Oklahoma, Arkansas, and Texas. This species is considered critically endangered or imperiled throughout a widely scattered but limited range. Its total global occurrence consists of

View of an open area by a seasonal creek
Hugh and Carol Nourse

Sedum pusillum (Puck's orpine)
Hugh and Carol Nourse

only twenty five known locations, with ten historical records that are believed to be extirpated (*Natureserve Explorer* online, 2004). The seepage areas are also home to one of the strict outcrop endemics, Georgia rush (*Juncus georgianus*), as well as weak rush (*Juncus debilis*) and Piedmont quillwort (*Isoetes piedmontana*). We have found spring ladies' tresses (*Spiranthes vernalis*) along with helmet flower (*Scutellaria integrifolia*) in June. As the other flowers begin to disappear, yellow-eyed grass (*Xyris jupicai*) blooms in August. Then in September comes the slender ladies' tresses (*Spiranthes lacera* var. *gracilis*), while in October we find nodding ladies' tresses (*Spiranthes cernua*).

Open Woods Dominated by Eastern Red Cedar

There are really two types of open woods habitat present at Rock and Shoals. In one the ground layer is dominated by grasses, principally needle grass (*Piptochaetium avenaceum*, syn. *Stipa avenaceum*); in the other it is mostly rubble and large boulders. Both areas are under threat from the invasive Chinese privet, which has overrun much of these habitats.

In March the rare disjunct granite whitlow grass (*Draba aprica*) blooms under two old eastern red cedars in one of the grassy-woods sites. This Georgia endangered plant has its primary range in the Ozark Plateau of Arkansas and southern Missouri. About the same time in early spring, glade thimbleweed (*Anemone berlandieri*) shows up. Wild petunia (*Ruellia caroliniensis*), blephilia (*Blephilia ciliata*), dayflower (*Commelina erecta*), and firepink (*Silene virginica*) can also be found here. On the more open edges of these habitats bear-grass (*Yucca filamentosa*) blooms in May and June. We have been unable to photograph bear-grass flowers here because deer always chomp off the flower stalks before we can get to them.

Some wonderful plants can be found in lightly shaded areas that include more rock rubble and boulders covered with hedwigia moss (*Hedwigia ciliata*). There in March you will find early saxifrage (*Saxifraga virginiensis*) blooming. It is often the first flower of the year on the outcrop.

Puck's orpine (*Sedum pusillum*) blooms from March to May in hedwigia moss, or occasionally amongst resurrection moss, under the eastern red cedar trees. It is one of the few strict endemics on outcrops in the Piedmont, and is one of the protected plants of Georgia. Although very similar to elf orpine, it begins to bloom earlier, is usually in these shady areas rather than sunny spots, and its leaves are usually bluish green rather than red. The best way to distinguish them is by their fruit. "In *Diamorpha* the fruit opens by a small flap on the underside. In contrast, in *Sedum* the fruit opens by a longitudinal slit on the top side." [Patrick, et. al. (1995)]

Later in April the hairystem spiderwort (*Tradescantia hirsuticaulis*) and an outcrop endemic, spotted phacelia (*Phacelia maculata*) bloom. The hairystem spiderwort also appears on the open rock at the edges of boulders, or in

grassy areas it may encircle a fire ant mound.

Ferns occurring in this community include hairy lip fern (*Cheilanthes lanosa*) and blunt-lobed cliff fern (*Woodsia obtusa*), as well as the ubiquitous ebony spleenwort (*Asplenium platyneuron*). On the branches of the eastern red cedar trees you can find resurrection fern (*Pleopeltis polypodioides* ssp. *michauxiana*).

Conclusion

We hope that the management plan for Rock and Shoals will provide for trails that will allow people to visit this site without damaging its beautiful and delicate communities. Over the years, botany students have studied taxonomy here, landscape architecture students have observed its natural landscapes, and school-children have come to learn about biodiversity. May this continue to be a place for learning about the most unusual habitat in the Georgia Piedmont, while being preserved for future generations.

Appendix

Directions to Rock and Shoals Outcrop Natural Area: The site is located in the southeastern part of Athens-Clarke County. If you are driving to Athens on GA 316 from Atlanta, when you arrive at the Athens By Pass, GA 10, take the right ramp going east. Drive to the second exit, South Milledge, and turn right (east). You will pass the State Botanical Garden of Georgia, which might be a good stop for restrooms, since there are none at the site. Continue on South Milledge until you come to a fork just before a stop sign. Take the left fork, and at the stop sign turn left onto Whitehall Road. Go across the Oconee River up the hill and to the first traffic light. Turn right at the light onto Barnett Shoals Road and continue past Barnett Shoals School. Rock and Shoals subdivision will be about a mile past the school on the right. There is a big rock pile at the entrance. Turn right on Rock and Shoals Drive and go to the end of the paved road. Park on the road. The trailhead, with a mailbox for maps, is on the right along the muddy extension of the road just before you reach the chain-link fence. Go down the rough staircase to reach a path marked with blue engineer tape leading to one of the outcrops.

References

Brodo, I. M., Sharnoff, S. D., Sharnoff, S. *Lichens of North America*. Yale University Press, New Haven, 2001.

Burbanck, M. P. and Platt, R. B. "Granite Outcrop Communities of the Piedmont Plateau in Georgia." *Ecology* 45: 292–306, 1964.

Natureserve Explorer online, www.natureserve.org/explorer/. 2004.

Patrick, T. "Rare Plant Checklist No. 2, Piedmont Granite Outcrops." Georgia Natural Heritage Program, 1998.

Patrick, T., Allison, J. R., and Krakow, G. *Protected Plants of Georgia*. Georgia Department of Natural Resources, Wildlife Resources Division, Georgia Natural Heritage Program, Social Circle, 1995.

Radford, A. E., Ahles, H. E., Bell, C. R. *Manual of the Vascular Flora of the Carolinas*. The University of North Carolina Press, Chapel Hill, 1968.

Rock and Shoals Outcrop Natural Area, Management Plan. Georgia Department of Natural Resources, Wildlife Resources Division, Georgia Natural Heritage Program, 2002.

USDA.. *Integrated Taxonomic Information System* [http://www.itis.usda.gov/], 2002

Wyatt, R., and Allison, J. R. "Flora and Vegetation of Granite Outcrops in the Southeastern United States." In Porembski, S. and Barthlott, W. (eds.) *Inselbergs*. Springer-Verlag, Berlin. *Ecological Studies* 146: 410–433, 2000.

Wayne Morris and students at St. Joseph Peninsula State Park

Heath Biggers

Students with Kay Kirkman at Ichuaway Plantation

Heath Biggers

Field Botany and Higher Education in Georgia: A Mutualism

Wayne Morris

Preface

I wrote this article from the perspective of a professor at a teaching-oriented state university in Georgia. In our Department of Biology at North Georgia College & State University, we have approximately 300 majors; and many of these pursue biology as the first step toward becoming a health professional. Students often come into a botany class dreading the thought of having to learn about plants, organisms that to them seem totally unrelated to their career plans. To try and grab their attention, and hold it, where plant taxonomy, ecology, and plant conservation are concerned, I include examples having direct impacts on people. This article is sprinkled with such examples while addressing educational opportunities, experiences, and successes in field botany and also addressing the need for a balance between field and molecular biology.

Introduction

We all know Georgia is a hot spot for plant diversity with a regionally distinct flora for each physiographic region. Sites range from prairies, glades, and hardwood forests on calcareous areas in the Ridge & Valley and Cumberland Plateau, to vernal pool communities on acidic granite outcrops in the Piedmont, to the often sandy coastal plain, historically characterized by extensive longleaf pine forests, to the rich cove forests and high-elevation boulderfields of the Blue Ridge. Our state supports over 3,600 species of vascular plants, which include ferns, pines and other conifers, and flowering plants. In addition, approximately sixty-six percent of the land is forested. At the same time, Georgia has the tenth largest population in the United States; and in part due to our rapid growth, urban expansion, and alteration of natural habitats, about 250 species of plants are on the verge of extinction. Given these statistics and the range of growing conditions in Georgia, it is easy to see why there is both an interest and a need to educate people about our native plants and plant communities.

At recently held regional and national scientific meetings, several presentations and even whole symposia addressed the need for field botanical education nationwide. The title of the 2003 Association of Southeastern Biologists meeting symposium on this topic was "The Crisis in Field Botanical Education." As far as the academic side is concerned, one presenter, Dr. Zack Murrell of Appalachian State University, concluded that regional comprehensive universities are excellent places to pursue a field botanical education based on surveys of herbaria and trends in botany courses offered across the Southeast.

At North Georgia College & State University, one of thirty-four institutions in the University System of Georgia and one of thirteen state universities, we acquired a new, state-of-the-art science building shared between the departments of Biology, Nursing, and Physi-

cal Therapy. The administration supported a herbarium suite in this facility completed two years ago, and it was designed to have a specimen preparation room with a botanical library and an ultra-low freezer, a drying room, and a specimen room where the herbarium cabinets with finished samples of native and naturalized flora of Georgia and adjacent states are housed. So far, the herbarium, associated field study classes, and undergraduate/graduate research projects have proved to be excellent resources to generate student interest in field botany.

NGCSU Plant Taxonomy Field Studies

In the upper-level plant taxonomy classes (which are senior/graduate level electives), meeting times usually consist of combination lecture/discussion/laboratory sessions. Over the course of these sessions, the systematics, identification, and natural history (including pollination mechanisms, life cycles, and general ecology) of vascular plants are discussed and investigated as well as the uses of these plants (including scientifically documented pharmaceutical properties, edibility, toxicity, and use in the urban and rural landscape). Concerning the systematics of vascular plants, the topics progress from the plant families currently hypothesized to be most like the ancestral vascular plants to those families currently thought to be the most advanced angiosperms. Many sessions in the classroom, laboratory, or field involve hands-on experience keying out a number of unknown plant specimens employing the use of the dissection microscope, the hand lens, one of several manuals on the flora of the southeastern United States, and the students' own critical thinking skills.

As mentioned earlier, the NGCSU Biology Department offers field study courses in ecology, marine biology, and plant taxonomy. These are four-day field trips to the Okefenokee Swamp and Sapelo Island in Georgia, to Ichauway in southwest Georgia, and Cape San Blas, the Apalachicola National Forest, and Torreya State Park in Florida, respectively. The plant taxonomy field study to southwest Georgia and the Florida panhandle is designed to: (1) give introductory plant taxonomy students a well-rounded perspective on the diversity of vascular plant families and species in Georgia and in the southeastern United States in general; (2) to stimulate individuals taking the course to compare and contrast the major taxonomic groups comprising the plant communities of the mountains, the Piedmont, and coastal plain; (3) to introduce students to the ecology of plants occurring in the outer coastal plain of our region, especially in terms of their adaptations to various soil types (most notably with respect to soil moisture, nutrient content, texture, and pH), frequency of natural or prescribed fires, and predominantly subtropical climate; and (4) to enhance oral presentation skills of participating students.

Regarding the last objective, students research assigned topics (Figure 1) prior to the trip and develop outlines and visual aids to supplement their oral presentations to be given in the field. Delivery of information is in the form of a "mock" scientific meeting with an *in situ* perspective. Presentations are evaluated by peers and by me using standard criteria established by the class including effectiveness of communication, appropriateness of handouts/diagrams/visual aids for developing the topic, and enthusiasm. Feedback from students indicates that this approach benefits their development as educators, as scientists, and as individuals:

"Field studies are the best way to stimulate your thinking."

"Great assignments. Each presentation given was different, yet very informative."

"required broad base of knowledge and many applications of learned knowledge"

"The course is very demanding, but it is a lot of fun. I learned more in this class than I have learned in any other."

Does the grade accurately reflect your understanding?—"Yes, but the level of knowledge I gained could not be quantified in any way."

Figure 1. Examples of plant taxonomy field study oral presentation topics.

1–8. Discuss general morphological characteristics (including a key), general ecology (life history, habitats in which species are usually found, special adaptations to habitat, response to fires, pollination biology, etc.), and potential medicinal, edible, or poisonous properties of any one of the following taxonomic groups present in south Georgia and north Florida:

1. the genus *Pinus*—Pines
2. *Poaceae*—focusing on characteristic longleaf pine sandhill grasses
3. *Orchidaceae*—Orchids
4. *Arecaceae*—Palms
5. *Aquifoliaceae*—Hollies
6. *Ericaceae*—Azaleas, Blueberries, Fetterbushes, and other Heaths
7. *Fagaceae*—Oaks
8. *Clusiaceae*—St. Johnsworts

9–19. Discuss adaptations of the vegetation and species composition in the following habitats of south Georgia and north Florida:

9. seagrass beds
10. salt marshes
11. coastal sand dunes
12. coastal sand pine scrub
13. longleaf pine sandhills
14. maritime hammocks
15. pond cypress swamps and comparison with bald cypress swamps
16. Atlantic white cedar swamps
17. pitcher plant bogs and savannas
18. steephead ravines and comparison with north Georgia flora
19. general morphology, ecology, and comparison of carnivorous plant families: *Droseraceae, Lentibulariaceae, Sarraceniaceae*

"This class gave me a deeper appreciation for fragile environments and the need to protect them."

"Going to so many different communities back-to-back helped me compare and contrast them. Doing the oral presentations helped me get a unique perspective on the environment. Laid back atmosphere contributed to my learning."

"This class was challenging and enjoyable. Being in the field was imperative to understanding plant habitats and plant relationships."

Let us hope that higher education administration in Georgia continues to support field studies such as this in this time of tight budgets, just as Georgia's college student population is dramatically increasing (Ex.: 2,200 to over 4,500 students at NGCSU in the decade I have been here).

Field Trips in General Botany Classes at NGCSU

Field trips in sophomore-level botany courses at NGCSU emphasize plant structure/function relationships, plant community recognition within the temperate deciduous forest biome and relating the plant community types to various topographic positions in watersheds, and interactions among species of plants and between plants and other organisms and their environment. The latter range from mutualism (exhibited by lichens, root nodules inhabited by *Rhizobium* bacteria on legumes, and also by mycorrhizae associated with the roots of several native orchids) to parasitism (exhibited at varying degrees by lousewort, *Pedicularis canadensis*, beechdrops, *Epifagus virginiana*, and dodder, *Cuscuta compacta*) and a discussion of primary plant succession while observing a seral stage on a rock outcrop. Any native plants encountered with scientifically documented pharmaceutical properties or those that are edible, toxic, or useful in the urban and rural landscape are also highlighted, especially since many of our approximately 300 biology majors have career plans in the health sciences. How many of you knew that something as basic as aspirin-like compounds were originally discovered in stems of willow trees (*Salix* spp.)? The analgesic salicylic acid is named after the Latin genus name for willows, and commercial aspirin is the chemically synthesized acetyl-

Sarracenia leucophylla (white topped pitcher-plant)
Heath Biggers

salicylic acid, patterned after the compounds found naturally in willows. The goal here is not to encourage students to ingest parts of wild plants with these special properties, but to get them to realize the value and impact native plants have on our modern world, even if they are not the direct sources (albeit original sources) of useful products we often take for granted. This, in turn, will hopefully make students more conservation-conscious and respectful of the natural world as they enter the professional world. The list of frequently used plant products in hospital and clinical settings goes on and on (Wilson, 1992): atropine from belladonna in the tomato family to dilate pupils of patients undergoing laser eye surgery, digoxin from foxgloves (*Digitalis*) to regulate proper heart rhythm in cardiac patients, diosgenin from wild yams (*Dioscorea* spp.) for birth control pills, morphine as a painkiller in hospitals, quinine from the cinchona tree in the Andes to combat malaria, and a whole host of anticancer drugs such as taxol from the Pacific yew (*Taxus brevifolia*), a conifer with relatives in the Florida panhandle and in the northeastern United States, for treating ovarian cancer, and vinblastine and vincristine, alkaloids from, of all plants, the Madagascar periwinkle (*Catharanthus roseus*). The latter are compounds causing certain forms of leukemia to go into remission, even when all other treatments failed. The above list also well illustrates that there is a continuum between medicinal and toxic plants. In fact, many of these medicinal plant extracts can only be administered in minute doses after having been extracted and purified by pharmaceutical companies; if given in larger doses, they can be deadly. After all, the compounds were originally developed in the plants for defense against herbivores and pathogenic fungi and bacteria just as the antibiotic penicillin produced by the *Penicillium* mold is used by the fungus to ward off competing fungi and bacteria. The above list also emphasizes the extraction technique students learn in the organic chemistry lab (and thus one of the many connections between biology and chemistry), used to isolate desired chemical compounds from those that are potentially harmful or otherwise undesirable.

NGCSU Student Research Projects in Field Botany

I especially enjoy interacting with students via independent study/research and seminar courses that are centered on field botany. These are excellent ways in which faculty and students can collaborate. Much of the current scientific research is done by teams of investigators, so this collaboration is a simulation of professional life after NGCSU. Although field botanical research projects can be labor-intensive, the equipment needed for them is cheap relative to many other sciences; and students really get to know their subjects and plant communities by studying them in their natural surroundings. Students with whom I have worked have conducted floristic studies of specific sites ranging from calcareous bluffs in the Ridge & Valley (Gordon & Bartow Counties, Georgia) to granite outcrops and adjacent habitats in the northern Piedmont

(Glade Shoals in Hall County, Georgia) to habitats typical of the Blue Ridge/Piedmont interface on land owned by NGCSU (Pine Valley Recreation Area in the Etowah River Watershed and a recent 200-acre acquisition in the Chestatee River Watershed, both in Lumpkin County, Georgia). The students and I have provided data to the proper authorities in the state on protected, rare, threatened, or endangered plant species so that proper management and monitoring plans can be implemented. Some of these taxa of special concern are the following: pink lady's slipper (*Cypripedium acaule*), yellow lady's slipper (*C. parviflorum*), oval ladies'-tresses (*Spiranthes ovalis*), bristly dewberry (*Rubus hispidus*), and ginseng (*Panax quinquefolius*). Students have shared their work by giving presentations at the annual NGCSU Honors Day event (Smallwood, 2001) and also for the Georgia Academy of Science (Tatum et al., 1998, Greenlee et al., 2001; Lewis et al., 2001; Burke et al., 2004) and Association of Southeastern Biologists (Morris and Henderson, 2000). It is exciting to watch students mature professionally and learn along with them via collaborative research projects with a focus on field botany.

Exotic Pest Plant Education and Servant Leadership

A number of botanical organizations across Georgia are providing wonderful opportunities for field botanical education. Among these is the Georgia Exotic Pest Plant Council, which organizes Privet Pull events in conjunction with Rivers Alive, Georgia's annual river cleanup taking place in October of each year. Students enrolled in my general biology and sophomore-level botany courses demonstrate and enhance their servant leadership skills by participating in these service learning activities. Before these events, students research the identification, biology, and control of Chinese privet (*Ligustrum sinense*) as well as several other top ten exotic pest plants including kudzu (*Pueraria montana*) and Japanese honeysuckle (*Lonicera japonica*). After conducting literature searches and taking part in the event, students write essays about biological pollution. A number of students have earned leadership points in SFCS 1000/Strategies for College Success and have also very successfully presented the subject to their COMM 2110/Speech Communication classes. It is especially rewarding to see students involved in public service and to see them educating their peers and families while they are learning course content. This helps accomplish one of my goals as a teacher: to instill confidence, skills, and knowledge in my students so that they will have the tools to make a difference in society. Following are some quotes from the students' essays about their experience battling one of Georgia's worst invasive plant species and concerning exotic plants in general. I try to impress upon them that battling exotic pest plants is like battling disease; we will never totally get rid of invasive plants, but we can try to keep them in check by close monitoring and by continually developing management strategies. Students also suggest appropriate natives in place of the exotic pest plants.

"Homeowners who have Chinese privet often do not realize that what they have bought from the store is invasive. This ignorance is often due to the supplier's lack of informing the purchaser. The homeowner sees the small-scale effects of their hedge; it looks good year round, thrives, and works very well to block the neighbors' view of their yard. These individuals should be educated on the invasive potential of these plants in hopes that they will find alternative native plants for their yards. After the Privet Pull, I got the urge that very weekend to eradicate Chinese privet in my own backyard."

Kathleen Mawhinney (Biology)

"Growing up in the north Georgia mountains over the past twenty years, I have become very familiar with plants such as kudzu and mimosa. I have watched as such plants have taken over our woodlands and hillsides, but little did I know that these plants were exotic. I was also unaware that there were other plants such as

Chinese privet and Chinese wisteria that are as destructive, if not more so than the former species. People need to be educated about the major problems at hand and be given the opportunity to do something about the situation now!"

Shane Padgett (Biology)

"Out of the top ten exotic pest plants in Georgia, nine of them are native to Asia. The climate there is similar to ours. Often in society we are more concerned with water and air pollutants than biological pollutants that are invading our communities. These pollutants are suffocating the native wildlife and destroying the homes of many organisms. The only way the United States will ever have a chance of ridding itself of these pollutants is if people take the time to help out in their communities. Then perhaps our native vegetation and wildlife will have a chance for survival."

Lindsay Googe (Biology)

"Georgia and the Southeast have many non-native plants that were introduced and have managed to escape cultivation. Now, these plants act like natives, but they are harmful to native plants because they crowd them out and compete with them for sunlight and nutrients."

William Jones (Pre-Med)

"Aliens in the Forest"—Title of essay

"Chinese privet made an impact on how I feel about man's influences on the environment. For some reason, it has taken me twenty-three years to become educated about the native vs. non-native issue. That is the sad truth. It took two classes (thirty participants) two hours to make a difference at the Chattahoochee River National Recreation Area. Imagine the positive impact a nation of schools could have. I came in the morning and saw a dense forest of scrubby trees with virtually no low-lying shade-loving natives. It probably looked to the patrons of the park like we had done a terrible deed—like we had ripped through their beloved forest with a chainsaw. I feel sorry they don't know what I have learned. We have to make amends for our environmental mistakes. We brought them in; now it's time to chase them out and replace them with what was once rightfully there."

Catherine Eastman (Biology)

Field Botanical Organizations in Georgia

Both the Georgia Botanical Society and the Georgia Native Plant Society are promoting field botanical education. Each organization has field trips and/or symposia on the native flora of Georgia, and college students are strongly encouraged to attend. A number of these target students who are planning to become high school science teachers; and by participating in the events, students are provided with resources to help them incorporate plant biology in the secondary schools. Presenters at the meetings include professors of landscape architecture, foresters, and national award-winning horticulturists advocating the ethical use of native plants in commercial and residential landscapes. NGCSU students have written articles based on what they have learned by participating in these events (Cipolla, 2003; Riley, 2004; Williams, 2004). In addition, both organizations have developed grant programs to support undergraduate or graduate student research; student recipients attend both the large research universities in Georgia and the regional state universities.

The Georgia Plant Conservation Alliance (GPCA) based at the State Botanical Garden of Georgia and the University of Georgia is an organization comprised of representatives from federal, state, and private conservation agencies as well as from the major botanical gardens in the state and from the University System of Georgia. This organization has obtained major grants to fund graduate student research and to provide internship programs centered on field botany. Founding members in the organization have also developed a network of public schools, including many elementary schools, that are educating their students about

Georgia's fragile environments and unique flora; this has been facilitated through an Eisenhower grant program. The GPCA has provided opportunities for NGCSU students to learn more about protecting endangered plants by allowing them to participate in monitoring and managing a safeguarding site for the purple pitcher plant (*Sarracenia purpurea*) in the north Georgia mountains. Safeguarding sites are reservoirs of genetic diversity for some of our rarest plants in case some natural or man-influenced disaster destroys the small, vulnerable natural populations. For example, purple pitcher plants at the safeguarding site mentioned above were propagated from seed at the Atlanta Botanical Garden and then outplanted at a site closely simulating sites supporting the species naturally. Seeds were collected from wild Georgia populations. If the natural pitcher plant populations were to disappear, seeds from the safeguarding sites could be used for recolonization, thus preserving original Georgia genetic stock.

Zigadenus densus (Osceola's plume)
Heath Biggers

BIO 2010 Report of the National Research Council

BIO 2010: *Transforming Undergraduate Education for Future Research Biologists*, a recent publication by the National Research Council (2003), points to future directions in biology. Molecular biology, with many exciting opportunities, challenges, successes, and ethical questions for students, is figured prominently in the publication. Biology Department faculty from a significant number of colleges and universities have expressed concern that some schools are using the BIO 2010 report to sideline, or even eliminate, studies in ecology, population and evolutionary biology, and other non-biomedical subject areas in the undergraduate life sciences. Current National Academy of Science President Bruce Alberts has cited such attitudes on college campuses are "misinterpretations" of the 2010 report—that it is not intended to cause life science departments to forego a *whole* approach to biology.

Field botany and molecular biology (and field botany and the biomedical sciences, for that matter) are not as far removed from one another as one might think. As discussed earlier, medicines, nutrients, and toxins derived from plants with dramatic effects on humans are at the molecular level in the hierarchy of life. These include antioxidants, substances that guard plant cell DNA from damage by excess radiation. If we incorporate plant parts high in anthocyanins (blue to reddish-purple to black pigments) in our diets, particularly fruits such as blueberries, blackberries, eggplant, etc., we, too, can help guard our DNA from spontaneous mutations that could potentially lead to cancer. Not only do plants use the pigments to help protect their seeds, their next generation, they use them to announce to potential vertebrate dispersal agents that their fruits are ready for consumption at that time and that their seeds are ready for dispersal. As it turns out, red or black colors are conspicuous to most vertebrates but very inconspicuous to most invertebrates such as insects that would be too small to perform adequate dispersal

Helenium vernale
(spring Helenium or Savannah sneezeweed)
Heath Biggers

for the plants. So learning about plants rich in such molecules in the field as well as in the laboratory can help biologists integrate knowledge at multiple levels. Herbaria and molecular biology can be mutualistic, too. The University of Alabama Herbarium illustrates this well; a molecular laboratory is adjacent to the herbarium cabinets housing specimens collected from the field. Chloroplast DNA can be extracted and amplified from herbarium specimens and can be used for studies in molecular biology. Papers addressing evolutionary relationships among various groups of plants have used this as a source of taxonomic evidence—one more piece in the jigsaw puzzle to try and make sense of the natural phenomena of Creation.

Field Botany and Higher Education: A Mutualism

Some life science departments across the nation strive for overall balance among the ecological, organismal, and molecular subdisciplines of biology. In doing so, they are taking an approach Aristotle would have advocated. One could compare this approach to a mutualism, where both partners involved in a relationship benefit from the relationship and are usually held in a delicate balance. A classic example of mutualism is a lichen, in which a green alga or cyanobacterium manufactures carbohydrate (sugar) for itself and its fungal partner and the fungus (typically a sac fungus) provides a protective home for the alga or cyanobacterium and dramatically increases the surface area through which water and minerals can be absorbed. As discussed above, there really is a continuum, a "mutualism" among the different subdisciplines of biology; and each subdiscipline can benefit by reinforcing connections with the other subdisciplines.

Upon closer examination, not all mutualistic relationships involving plants appear to be beneficial to both partners involved at any given instant in time. In fact, it might appear that one is parasitic on the other until the whole life history of the association is revealed. The partners are usually maintained in a balance; but like all relationships, they, too, can go astray if not kept in check. An example of this latter form of mutualism is the association of mycorrhizal fungi and the roots of orchids. Orchid seeds are the size of dust because unlike the seeds of most other flowering plants, they lack stored food and are simply rudimentary embryos. They are so highly reduced that they do not even have a cotyledon ("seed leaf"), even though they have been classified as monocots. Typically, cotyledons are the first photosynthetic structures in higher plants and help jumpstart the growth of the first true leaves, which in turn make even more food. Because orchid seeds lack stored food, they must link up with the appropriate mycorrhizal fungus in the soil or on tree bark to germinate. Early on in this relationship, it appears that the orchid is only taking from the fungus all of the water and nutrients it needs and giving nothing in return. After the orchid develops fully expanded green leaves, roles of the two partners reverse. The orchid then provides carbohydrate to its fungal associate. When broken down into stages, it appears that the orchid/mycorrhizal fungus relationship is a parasitism; but when the entire life history is considered, it is actually a mutualism. I use this as a prime example of doing "quick-and-dirty" science to my students and jumping to the wrong conclusions unless one carefully studies his/her subject(s) in a logical, scientific manner

over an adequate period of time or after replicating the same experiment a sufficient number of times. Anyway, the relationship between orchid and fungus can get even more interesting. It has been shown that early in this cycle, the orchid can be overly aggressive on the fungus. When this happens, it may kill the fungus, thereby killing itself. Later in life, the fungus can become overly aggressive on the orchid and do harm to both. Orchids have natural built-in antibiotics called phytoalexins that they use to keep even their beneficial partners in check. As with the human immune system, they may not always work as they should and lead to the relationship going astray. This is truly an intricate, very remarkable phenomenon.

If life science departments are cyclic and advocate certain subdisciplines of biology over other subdisciplines for a couple of decades or more, they eventually realize there is an imbalance and recognize the need for what they are lacking. This could be comparable to the orchid/mycorrhizal fungus relationship that goes through distinct phases when kept in check. Of course, if some departments go overboard with one line of thinking, they might lead to their overall demise, similar to the orchid/mycorrhizal fungus relationship gone astray. Let us hope that the state of affairs is not as drastic as either of these scenarios in Georgia and that there is more of an obvious continual mutualism. This would be in line with a major goal of education: to integrate all knowledge. As briefly described above, field botany really does cross many boundaries, teaches us many lessons, and has positive impacts on our lives that we may not always realize on a day-to-day basis.

Literature Cited

Burke, L. S., W. Jones, B. T. Mullis, J. M. Wisdom, J. L. Lipchinsky, L. M. Bruce, L. Ownby, and M. W. Morris. "A Floristic Study of the North Georgia College & State University Property and Environs in the Cane Creek Watershed, Lumpkin County, Georgia." *Georgia Journal of Science* (in press), 2004.

Cipolla, J.. "A Teacher's Perspective." *NativeSCAPE* 9:5, 2003

Greenlee, J. R., L. N. Smallwood, and M. W. Morris. "A Floristic Study of Glade Shoals Granite Outcrop and Adjacent Habitats, Hall County, Georgia." *Georgia Journal of Science* 59:27, (Published abstract) 2001.

Lewis, M., M. Davis, and W. Morris. "Prey Capture in a Montane Purple Pitcher Plant (*Sarracenia purpurea*) Population." *Georgia Journal of Science* 59:28, (Published abstract.) 2001.

Morris, M. W., and S. A. Henderson. "A Survey of Selected Savannah River Bluffs and Adjacent Environments from Lincoln to Effingham Counties, Georgia, for Rare and Endangered Vascular Plants." *The ASB Bulletin* 47:169–170, (Published abstract.) 2000.

National Research Council. *BIO 2010: Transforming Undergraduate Education for Future Research Biologists.* The National Academies Press, Washington, D. C. 191 pp., 2003.

Riley, S. "Native Grasses." *NativeSCAPE* 10:1–3, 2004.

Smallwood, L. N. "Summer Flora of Selected Calcareous Bluffs in Bartow and Gordon Counties, Georgia." *Honores: The NGCSU Journal of Undergraduate Research* 1:34–47, 2001.

Tatum, H. R., R. G. Moore, S. L. Butram, J. M. Ward, and M. W. Morris. "Summer flora of Pine Valley Recreation Area, Lumpkin County, Georgia." *Georgia Journal of Science* 56:131–148, 1998.

Williams, A. "Butterfly gardening." *NativeSCAPE* (in press), 2004.

Wilson, E. O. *The Diversity of Life.* W. W. Norton & Company, New York. 424 pp., 1992.

Sabatia capitata Annual or Perennial?

Al Good

The Cumberland rose gentian (*Sabatia capitata*) is one of those rare flowers with such a restricted range that most of the manuals do not include it. The species is quite thoroughly described in *Protected Plants of Georgia* (Patrick, Allison, Krakow 1995), but the statement therein that the plant is an annual did not fit our casual observations. This note describes more systematic observations to answer the question posed in the title.

The recorded range of the species is limited to a southwestern portion of the Cumberland Plateau and adjacent foothills in northwest Georgia, and nearby Tennessee and Alabama. Occurrence in seven Georgia counties is described in the above mentioned publication. The Georgia Botanical Societies *Atlas of the Vascular Flora of Georgia* (Mellinger 1984) provides a basis for interesting speculation. *Sabatia capitata* is not shown, but anomalous northwest Georgia occurrences of *S. gentianoides* to which *S. capitata* would key in the *Manual of the Vascular Flora of the Carolinas* (Radford, Ahles, Bell 1968) are presumed to have been *S. capitata*. This presumption leads to the possibility that a *S. gentianoides* occurrence listed for Rabun County in northeast Georgia was *S. capitata*. This possibility is particularly interesting because the material which Rafinesque used to describe the species was said to have been collected in the Cherokee Indian Country of southeast Tennessee where we have no modern record of its occurrence.

Sabatia capitata (Cumberland rose gentian), basal rosette in ground with stems
Al Good

The rose pink flowers are quite showy in contrast to the mostly yellow ones of other species found flowering at the same time and places. The inflorescence on well developed plants can have more than twenty stemless flowers both terminal and axillary on vertical stalks 50–60 cm tall. Individual flowers can be five cm in diameter with usually eight (7–12) petals, sepals and stamens. Occasionally a plant will occur with nearly white flowers. Opposite leaves are flat, entire, sessile, and oval tending to a pointed tip. Flowering time is late July. It is differentiated from other Sabatias by more than five petals, stemless or nearly stemless flowers and flat thin leaves. *S. gentianoides* has similar flowers but fleshy linear upper stem leaves.

The fact that 50% of *S. capitata* plants survived for a second season (only) in a rescue dig suggested that the plant was not an annual. The ambiguity in this result was later removed by a single plant found flowering at a Tennessee

Sabatia capitata (Cumberland rose gentian), plant in flower with multiple stems Al Good

location where it could be protected and monitored. The plant was growing in sandy soil and was not fed or watered during the subsequent years of observations. In the first fall after the flower was found, two furled rosettes of new leaves formed at ground level and stayed that way over winter. During the following spring and summer only one of the rosettes developed into a larger branched plant. The next winter the stem rosettes were too congested to count precisely but seven branched stems were produced having more than forty flowers.

Sabatia capitata, basal rosette before being separated
Al Good

Sabatia capitata, plants after being divided
Al Good

After these three seasons of flowers, the plant produced another clump of stem rosettes. In February the plant was dug and cleaned to see the crown and root structure. Fourteen stem rosettes had formed on both the crown and base of some previous year's stems a few mm above the crown.

Before replanting, division of the crown was attempted. Plant morphology was not well suited for division in that few stems could be obtained with associated roots. The best divisions was replanted into the soil where the plant had been growing and the others were planted nearby.

Overwintering leaves were confirmed on wild plants in Floyd County. Plants were located that had remains of the summer flower stems. Winter leaves, like the ones on the single Tennessee plant, were at the base of these plants also.

Though we now know *S. capitata* to be a perennial, the species is thought to be short lived. Further, we have a poor understanding of the conditions required for seed germination. Seed don't germinate with treatments usually effective with other native flowers. Occurrence in the wild is most frequently associated with soil disturbance by earth moving equipment. They are found on roadsides, recently plowed pine plantations, power line ROW's, and new residential subdivisions. A population at one site in a Tennessee State Forest was kept going by driving a bulldozer over the site yearly. Before bulldozers, fire and associated erosion are presumed to have provided an appropriate seed bed. After two years of prescribed burns at the Floyd County, Georgia site, populations were found in areas not known to have previously supported this plant. Propagation requirements need to be better understood to provide a rational basis for management of this rare and beautiful species.

References

Brown, James C., personal communication.

Chester, E. W., et. al. *Atlas of Tennessee Vascular Plants, Volume 2*. The Center for Field Biology, Austin Peay State University, 1997.

Good, A. N. "Cumberland Rose Gentian." *Tennessee Native Plant Society Newsletter*, June 2002.

Mellinger, M. B. *Atlas of the Vascular Flora of Georgia*. Georgia Botanical Society, 1984.

Patrick, T. S. et. al. *Protected Plants of Georgia*. Georgia Department of Natural Resources, 1995.

Pickett, H. W. *Wildflowers of the United States; Southeastern States*. The New York Botanical Garden, 1967.

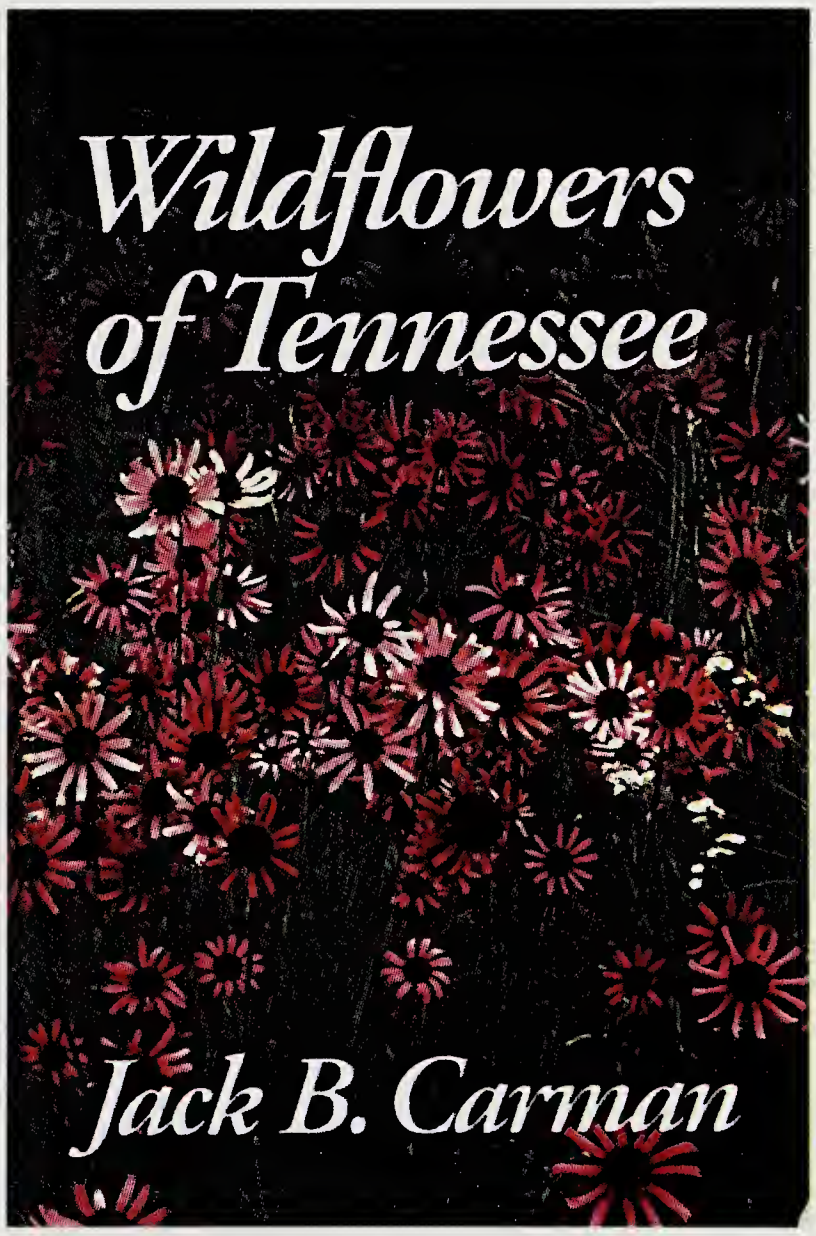
Radford, A. E. et.al. *Manual of the Vascular Flora of the Carolinas*. University of North Carolina Press, 1968.

Book Review

Wildflowers of Tennessee

by Jack B. Carman

Wildflowers of Tennessee, by Jack B. Carman, is published by Highland Rim Press, Tullahoma, Tennessee; © 2001 by Jack B. Carman; 427 pages; more than 780 color photographs; $27.95, or $29.95 with plastic cover. To order call (866) 668–9686 or e-mail: jcarman@wildflowerstn.com.



I can hear some folks asking the question, "Why are we reviewing *Wildflowers of Tennessee*, when the majority of our members live in Georgia?" Of course, the answer is that this book is very useful and relevant to Georgia (especially north Georgia), as well as to an area from Pennsylvania to Missouri, and from northern Mississippi to Georgia and northward to Virginia. This book is particularly useful here in northwest Georgia, where the coverage of the *Manual of the Vascular Flora of the Carolinas* (Radford, Ahles, & Bell) begins to fade. Since Georgia is not within the scope of books written strictly for the northeastern states either, this book fills a void.

Here is the pertinent information from the back cover, which is highly accurate for this book:

- The first comprehensive, statewide, full-color field guide for wildflowers of Tennessee.
- More than 780 outstanding color photographs.
- More than 1,100 species described, including most of the state's showier, non-woody, vascular plants.
- Plant color plates and descriptions are side by side.
- Excellent coverage for most of the eastern United States, particularly the Central and Southern Appalachians, and the

Ohio, Tennessee and mid-Mississippi river valleys.

- An indispensable addition to the library or field pack of every naturalist and wildflower enthusiast.

This book is not a flora, or a manual, but a pictorial field guide, with some of the clearest and most beautiful color photographs that I've seen in a wildflower book. Most of the photographs were taken by the author or George Hornal. The other contributing photographers were: Bob Hale, Alan S. Heilman, John MacGregor, Doug Malone, Dan Pittillo, Wally Roberts, Glenn Taylor, and Clay Thurston.

The layout of the book follows the classical manner, with the arrangement of families following Gleason and Cronquists, *Manual of the Vascular Plants of the Northeastern States and Adjacent Canada*, NYBG, 1991. Each image is accompanied by a brief description which includes: Family Name, Common Name, Scientific Name, Plant Description, and Additional Species. In the Plant Description section it gives the distinguishing features needed for identification, frequency of occurrence, habitat, range, and approximate flowering time. Under Additional Species we find other plants in the same genus that are not pictured, but are described. Helpful drawings are provided of leaf shapes and arrangements, flower parts, inflorescence types, and especially useful, a flower shapes section. Also, a glossary of scientific terms is provided.

This book has several strong points to recommend it. First, it has 780 beautiful (and accurate) color photographs, which is several hundred more than most books of its kind. Second, there are more than 1,100 species described out of the 2,800 species found in the state of Tennessee. Third, the photographs and the descriptions are together, not as with most books published lately, which use the cost-cutting measure of having the pictures all alone in the center of the book. And, fourth, here we find many species pictured (for whatever reason), that you don't usually see pictured in books of this kind at all. Therefore, I think this book would be a great addition to anyone's library or backpack.

About the author: Jack Carman was born in Mississippi and graduated from Mississippi State University with a degree in Aerospace Engineering. He is employed as an Engineer Specialist by Sverdrup Technology Inc. and has been a Tennessee resident since 1963.

The beautiful wildflower images presented in this book are the result of his long-time interests in nature photography and wildflower identification. His photographs have received numerous awards and appeared in several calendars. His articles and images have been published in the *Tennessee Conservationist* and *Tennessee Wildlife* magazines.

Jack's knowledge of the Tennessee wildflowers is recognized by both peers and professionals. He serves as a leader for field trips and photo workshops for the Gatlinburg Spring Wildflower Pilgrimage at the Great Smoky Mountains National Park. He also presents a wildflower program at the Wilderness Wildlife Week event in Pigeon Forge.

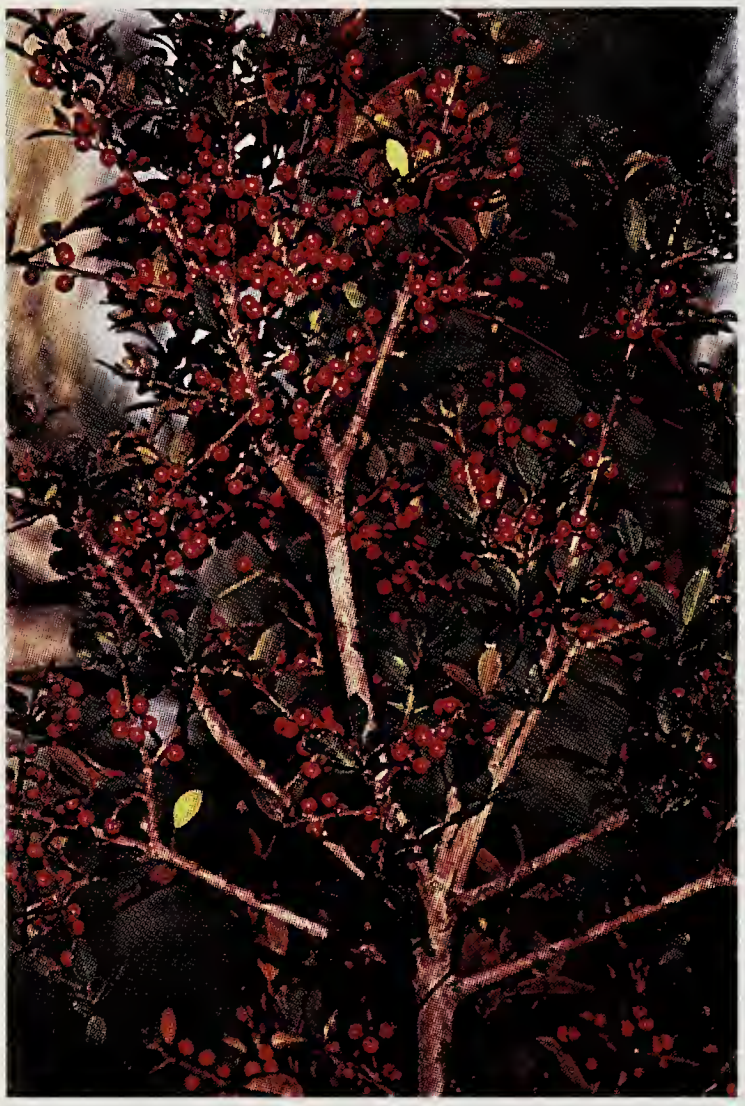
Reviewed by Richard Ware

of the state's natural areas. She is currently working, in partnership with other Botanical Society members, on a book on the natural environments of Georgia, continuing work started with Charlie Wharton. She serves on the boards of the Georgia Botanical Society and the Georgia Exotic Pest Plant Council.

Hugh and Carol Nourse are free-lance photographers specializing in plants and gardens in the Southeast. They were authors/photographers for two books: *Wildflowers of Georgia* (2000) and *The State Botanical Garden of Georgia* (2001), for magazine articles: *Tipularia*, *Wildflower*, and other magazines. As botanical guardians with the Georgia Plant Conservation Alliance, they have spent several years monitoring Rock and Shoals Outcrop Natural Area. Carol is treasurer of the Georgia Botanical Society (2003–2004). Hugh is currently membership chair (2003–2004), and has in the past been president, vice-president, and trip chair for the Society.

Michael Wayne Morris, Ph.D., is a professor in the Department of Biology at North Georgia College & State University. He teaches undergraduate and graduate courses including general botany, plant taxonomy, and general biology and has been recognized as a multiple-year honoree in the 2004 edition of *Who's Who Among America's Teachers*.

Wayne serves on the boards of the Georgia Botanical Society and the Georgia Exotic Pest Plant Council and is an officer for the Herbarium Curators Committee of the Southeast region. Research interests include floristics of the southeastern United States and vascular plant systematics, especially studies of *Orchidaceae*. With Jim Allison, he is working on the description of a new legume in the genus Pediomelum from serpentine outcrops in Columbia County. Field work has been supported by federal, state, and private granting agencies.



Ilex vomitoria (yaupon holly)
Brad Sanders

Tradescantia hirsuticaulis
(hairy spiderwort)
Hugh and Carol Nourse

Calopogon barbatus
(bearded grasspink)
Heath Biggers

Trillium underwoodii
(Underwood's trillium)
Leslie Edwards